Comments on Various Intermediate Work Products Related to the Wanaque Reservoir Phosphorus TMDL Proposed July 5, 2005

Submitted to NJDEP by New Jersey EcoComplex

Interim Report
Prepared by: New Jersey EcoComplex (NJEC) TMDL Advisory Committee
Submitted August 14, 2001

The purpose of this, and subsequent interim reports is to provide comments on the NJDEP's watershed management strategies, including those related to the development of TMDL values. The interim reports will be compiled into a formal report upon completion of the review process for each watershed. This interim report addresses Section II A of "Technical Approaches to Restore Impaired Waterbodies within the Non-tidal Passaic River Basin-DRAFT", which was submitted to the NJEC Committee by NJDEP, Division of Watershed Management, July 2001.

GENERAL COMMENTS

i. It is not clear from the draft whether or not a uniform modeling approach is to be employed statewide in the evaluation of the hydrology, chemistry, and biology of New Jersey's watersheds. The opinion of the committee is that such an approach would produce the most comparable results and defensible management strategies. Watershed evaluations would begin with a basin scale modeling approach to address the major issues first, followed by adaptive modeling on smaller scales to address specific local concerns. The statewide approach could employ an integrated system such as BASINS, which is being continually updated by the EPA and integrates already documented models. For example, the existing integrated model and database – the New Jersey specific version of BASINS, New Jersey Watershed System (NJWS), acquired through EPA Region 2 – could be used to provide uniform basin-scale evaluations of the state's watersheds. The committee recognizes that any statewide approach adapted will require modifications to better incorporate mechanistic modeling approaches, including but not limited to those for biogeochemical processes. In all cases, the committee recommends that there be thorough justification for specific modeling approaches.

ii. Throughout the NJDEP draft document, the term "water quality" is often used without a clear definition. For example, it is not clear which water quality conditions the model LA-WATERS successfully simulates based on the phosphorus loading (*e.g.*, total phosphorus concentration only?). It is imperative that, in its evaluation and development of watershed management strategies, the NJDEP be explicit when referring to "water quality".

iii. It would be helpful to the committee to include diagrams, with monitoring stations, in the technical approaches to supplement flow descriptions in the text (hand-markings on maps would be fine). Examples pertaining to the present draft are diagrams for the flow of the Ramapo River into Pompton Lake, the pumping stations associated with the Wanaque Reservoir, and the associated monitoring stations.

COMMENTS ON SECTION II A

1. Wanaque Reservoir TMDL

The third technical task in this section, which requires that LA-WATERS simulate management scenarios to achieve the water quality objectives defined in Task 2, implies that the model includes, for instance, sufficient algal/nutrient interactions for the task. As this is not clear, the committee would need a description of the processes included in the model, and how these meet the specified tasks before the use of LA-WATERS can be recommended. This may be done via a subcontract proposal. The committee recommends that such a proposal also justify the use of a 2-D model, as a 3-D model may be more appropriate for assessing excessive primary production where phosphorus-rich waters are pumped into the lower reservoir. This raises the issue of existing data resolution and monitoring needs in the reservoir, which a proposal should also address.

2. Pompton Lake and the Ramapo River TMDL

The committee agrees that it may be feasible to use an empirical analysis relating annual load to long-term mean phosphorus concentration to develop a TMDL for Pompton Lake. However, this would depend on there being a strong correlation between loading and concentration. Even then, this approach may be subject to criticism, because of the absence of some more direct measure of impairment, such as algal biomass. The committee therefore recommends that a model for nutrient/algal dynamics in Pompton Lake is needed to help in the development of a TMDL for phosphorus. Such a model would also enhance an understanding of the system for management purposes.

The committee agrees that data for total phosphorus within Pompton Lake are needed to evaluate the use of data from a monitoring station near the outlet of the lake as a proxy; this data collection should also address the lake hydrodynamics, specifically whether or not it is a well-mixed system. However, there may be further data requirements for the nutrient/algal modeling, and these should also be considered for any data collection effort within Pompton Lake. It is also recommended for the TMDL development that the technical approach include quantifying the various sources of point and non-point loading to Pompton Lakes.

3. Nitrate at Little Falls

The data shown does suggest that nitrate concentrations during low flows may be attributed to point source discharges, however the relationship between temperature and instream nitrification may be a complicating factor (*i.e.*, high temperatures often coexist with low flows). In order to strengthen the case for operational denitrification, the committee recommends that NJDEP better demonstrate that a significant fraction of the nitrate loading into the Passaic River is from point sources. For instance, an approximate

nitrogen mass balance may be conducted for this purpose using nitrate and ammonia data.

4. Passaic River basin dynamic flow model

The committee agrees that a robust hydrological model is needed along with water quality models. However, the committee is concerned that the proposed USGS modeling effort may not be directly relevant to the management questions NJDEP needs to answer. For instance, there is no justification for the proposed modeling effort over other approaches/models. Applying an existing framework such as NJWS to the non-tidal Passaic River basin may better facilitate the development of a statewide modeling approach. While the Diffusion Analogy Flow Model (DAFLOW) to be used in the USGS modeling effort was useful for the Whippany River Watershed Model, it may not be suitable for modeling all the Passaic River system stream reaches. DAFLOW is suitable for conditions where flow reversals do not occur and backwater conditions are not severe. Also, it is not clear from the USGS proposal how non-point source loadings and groundwater will be integrated into the overall system model. The expenditure needed to develop the proposed model, and its ultimate usefulness, is therefore in question.

5. Meadows nutrient study, and
6. Nutrient/Biological dynamics study

These two sub-sections of the draft are more general in nature than the preceding ones. While the committee generally agrees that the mentioned research is needed, the committee would like to better understand its role in their evaluation.

Interim Report
Prepared by: New Jersey EcoComplex TMDL Review Panel
Submitted July 30, 2002

This interim report addresses the draft proposal *Application of LA-WATERS Model for Phosphorus TMDL Analyses in the Wanaque Reservoir* by Najarian Associates, which was submitted to the Panel for review by NJDEP, Division of Watershed Management, on May 20, 2002. This draft was supplemented by a presentation to the Panel by Tavit Najarian and Poshu Huang of Najarian Associates on July 10, 2002, which this report also addresses. Charles Yanucil and Tom Amidon of NJDEP were also in attendance for the presentation.

RECOMMENDATIONS TO THE DEPARTMENT

In general, the proposal and presentation do address the modeling concerns noted in the Panel's August 2001 report to the Department.[1] However, the opinion of the Panel is that the final Scope of Work (SOW) should address the following in order to strengthen the proposed study and offer better technical support to the Department.

Model Verification

LA-WATERS was re-verified for the Department; it "successfully reproduced pumping and water quality conditions that occurred from 1991 through 1998," and so fulfills the requirement of quantifying the relationship between phosphorus loads and resultant reservoir water quality sought by the Department (from NJDEP document: *Technical Approaches to Restore Impaired Waterbodies within the Non-tidal Passaic River Basin* [2]). Najarian Associates presented example comparisons of simulations and time-series data to the Panel during the presentation to demonstrate the model re-verification.

The noted exception to modeling the Wanaque Reservoir as a 2-D system is when short-term lateral gradients occasionally develop in the southernmost portion of the Reservoir in response to large diversion inflows. The draft proposal notes that mixing in the Reservoir tends to limit the spatial extent and duration of such gradients when pumping ceases. These effects are thus considered transient and localized in the proposal, and are not deemed important controls on the long-term trophic state of the Reservoir,[3] which, according to the proposal and the presentation, the model reliably estimates via its reasonable simulation of dissolved oxygen (DO) and organic phosphorus (org-P) near Raymond Dam. The Panel generally accepts this reasoning.

It was clear during the presentation that the model better predicted surface DO and org-P near Raymond Dam than it did total phosphorus (TP). It was suggested by Dr. Najarian that the model successfully predicted the salient water quality variables (DO, and org-P or chlorophyll-a), and that there was a fair amount of scatter in the TP data. However, the lack of agreement between simulated and measured TP leads to the following suggestions for comparisons of model simulations and data. The following plots in the proposal would thus assist in clarifying the validity of LA-WATERS for use as a modeling tool for

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[1] From the August 2001 Panel report on *Technical Approaches to Restore Impaired Waterbodies within the Non-tidal Passaic River Basin-DRAFT*.

> The third technical task in this section, which requires that LA-WATERS simulate management scenarios to achieve the water quality objectives defined in Task 2, implies that the model includes, for instance, sufficient algal/nutrient interactions for the task. As this is not clear, the committee would need a description of the processes included in the model, and how these meet the specified tasks before the use of LA-WATERS can be recommended...The committee recommends that such a proposal also justify the use of a 2-D model, as a 3-D model may be more appropriate for assessing excessive primary production where phosphorus-rich waters are pumped into the lower reservoir. This raises the issue of existing data resolution and monitoring needs in the reservoir, which a proposal should also address.

[2] http://www.state.nj.us/dep/watershedmgt/DOCS/prb_restore_living.pdf

[3] In contrast to an algal bloom, which may be transient.

the given task, and address Panel concerns about the robustness of the model with respect to simulating TP in the reservoir:

- Predicted vs. measured TP near Raymond Dam
- Residuals of predicted vs. measured TP near Raymond Dam
- Predicted vs. measured DO near Raymond Dam at the surface and 5 feet from the bottom
- Residuals of predicted vs. measured DO near Raymond Dam at the surface and 5 feet from the bottom
- Predicted org-P vs. measured chlorophyll-a near Raymond Dam

Endpoints

The NJDEP document *Technical Approaches to Restore Impaired Waterbodies within the Non-tidal Passaic River Basin* also includes a task to develop one or more water quality objectives for the reservoir that will protect designated uses under the technical approach for the Wanaque Reservoir. It mentions that one way of defining excessive primary productivity in the reservoir could be by using a response variable such as DO or chlorophyll-*a* instead of the causal variable TP.

A stated objective of the proposed study by Najarian Associates is to support the Department's efforts to develop water quality objectives (quantifiable TMDL endpoints) that will protect the Reservoir's designated uses. "These may include site-specific criteria for limiting primary production in the Reservoir, rather than simply phosphorus concentration limits." There is a strong correlation observed between org-P and chl- *a* shown in the proposal, which states that the model also reliably simulates org-P concentration as a proxy for primary productivity. LA-WATERS may thus readily support the development of alternative water quality endpoints. Further, a proposed task is to analyze the relationship between component phosphorus concentrations and indicators of primary productivity to further the establishment of quantifiable endpoints. [4]

The Panel supports the need for alternative endpoints, and reemphasizes the importance of the stated task to the study.

[4] A potential use of LA-WATERS suggested by the Panel would be for a simulation study of management strategies (i.e., alternative pumping scenarios) and consequent chl-*a* dynamics to assess possible alternatives to the existing practice of herbicide shocking for control of excessive primary production. This may be a scenario option to consider in consultation with the Department, NJDWSC and the Workgroup.

This interim report addresses the presentation and the accompanying draft report *Development of Wanaque Reservoir TMDL and Cumulative TMDLs for the Pompton and Passaic Rivers* by Najarian Associates. The (thorough) presentation was made to the Department and the Panel by Tavit Najarian (President, Najarian Associates), on November 12, 2004, at Rutgers University. In attendance for the NJDEP Division of Watershed Management were Lawrence Baier, Barbara Hirst, Kimberly Cenno, Marco Al-Ebus, Karen Dorris and Theresa Botanic. Also attending were Susan Schulz and Alexander Remnak (USEPA Region 2), Pen Tao (North Jersey District Water Supply Commission), Tom Amidon (TRC Omni, Inc.), and Howard Litwick, Joe DiLorenzo and Poshu Huang (Najarian Associates).

A summary of the pertinent points made during the meeting is provided below; additional comments by the Panel are also provided to supplement those made at the meeting.

I. PANEL COMMENTS

A. Margin of Safety (MOS)

Section 6.4 of the draft report by Najarian Associates addresses the MOS for TMDL development for their study. This MOS is implicit in the modeling simulations (being about 20% for both the river and reservoir models), as explained in the draft report. However, discussion at the meeting indicated that USEPA requirements warrant further elaboration on the rationale and justification for this MOS, which will be followed up by Najarian Associates, NJDEP and USEPA. In general, the Panel's opinion is that the MOS based on the inclusion of 2002 in the ten-year model simulation is adequate, but this MOS needs to be better described in the report. The report would also need to describe the rationale and justification for the (implicit or explicit) MOS corresponding to nine-year model simulations (i.e., if 2002 is not used in the development of the endpoint for the Wanaque Reservoir; see Section E).

B. Assumptions for TMDL calculations

NJDEP had previously indicated to Najarian Associates that the boundary condition for TP (total phosphorus) concentration for the Ramapo River should be assumed not to exceed 0.1 mg/l.[5] The corresponding long-term average TP concentration in the draft report used for the alternative summer-average criterion simulations is not equivalent to this assumption; as indicated in Section 6.2, however, this assumption was applied for the current criterion simulations. Further, the Department has pointed out that the TMDL calculations should also incorporate the TMDL that has been established for Greenwood Lake, whereby water exiting the lake should be assumed not to exceed the lake TP criterion of 0.05 mg/l. This does not appear to have been implemented in the draft report for either criterion. Previously and at the meeting, NJDEP mentioned that the same assumptions should be applied to Pompton Lake where a TP TMDL is planned, however,

[5] From a 10/22/04 NJDEP document: *Review of Draft Project Report "Development of a TMDL for the Wanaque Reservoir and Cumulative WLAs/LAs for the Passaic River Watershed" prepared by Najarian Associates, September 200*4.

USEPA pointed out that this would not be appropriate at this time since this TMDL has not yet been established.

Based on this assessment, the simulations for the study would need to be done over with a corrected set of boundary conditions.

C. Waste-load Allocations (WLAs) and Load Allocations (LAs)

In the October 2004 NJDEP document (see footnote 1), the Department indicated that the study would need to assign a discrete WLA to each regulated discharge that contributes phosphorus, including regulated stormwater.

> "Regulated discharges with effluent limits (e.g., municipal or industrial treatment facilities) will require a numeric mass/time WLA, while those that have general permits and utilize a BMP approach (e.g., regulated stormwater discharges) can have a WLA that is based on the required load reduction for NPS, applied to the surrogate land use for regulated stormwater (urban categories: residential, commercial, industrial). LAs can be expressed in terms of mass per time from each surrogate land use. Note that reductions can only be assumed from land uses that can reasonably be expected to have a load reduction. Loads currently contributed from forested, wetland and barren land uses should remain the same in the future scenario."

It should be noted that the expectations expressed in the above were established in a meeting between NJDEP and Najarian Associates as an elaboration and clarification of the original scope of work for this study. In the draft report and presentation, Najarian Associates assign the same long-term average (LTA) effluent concentration to all of the municipal point sources that discharge upstream of the various input sites to the Wanaque Reservoir, and do not assign discrete WLAs for each regulated discharge.

Specifically, the simulation results for future scenarios presented in the draft report show that all point source discharges would require a LTA TP concentration of 0.05 mg/l, concurrent with a 40% reduction in non-point source loading, to meet the target TP concentration of 0.05 mg/l at Raymond Dam. (Note that these results apply to the original, not corrected, set of boundary conditions for Greenwood Lake, as indicated above.) These results only provide simulated future TP concentrations for the New York State boundary, and the three intake locations (Ramapo River at Pompton Lakes, Pompton River at Two Bridges, and Passaic River at Two Bridges).[6] The above wording from NJDEP indicates that calculations for individual regulated dischargers are needed to verify that each reach downstream of individual treatment plants satisfies the TP concentration stream standard of 0.1 mg/l. These calculations are not included in the draft report.

[6] As a note, it should be indicated in Table 2.8 how the current loads were estimated for the wastewater treatment plants (i.e., these are not average calculations based on the table values for average current flow and effluent TP concentration).

Also, the draft report does not disaggregate NPS (non-point source) LAs as indicated by NJDEP in the above.[7] The Panel recommends that the LAs should be disaggregated, and that the final report should indicate exactly how these are calculated from discrete land-use categories that can reasonably be expected to have load reductions. For MS4s (municipal separate storm sewer systems), the Panel concurs with NJDEP that discrete WLAs for these point sources are needed for TMDL development.[8] In all cases, the final report will need to specify the discrete NPS loadings (e.g., in lbs/day or lbs/year), which are absent from the draft.

D. Basic River Model [9]

In a closed discussion with the Panel, NJDEP mentioned that it was assessing whether or not it was justifiable to apply the conservative mass balance river model utilized for this study to develop WLAs and LAs for all of the impaired segments of the Pompton and Passaic Rivers. Ms. Hirst suggested that perhaps this approach was justifiable for the impaired segments from the Wanaque Reservoir to Two Bridges, and that a more detailed water quality modeling effort being developed by TRC Omni in a separate project should be used in other cases. The issue as to whether or not the basic modeling approach used for this study is sufficient to calculate the above mentioned allocations in a scientifically defensible manner is discussed in this section. However, there are certain provisions in the New Jersey Administrative Code that also impact this discussion; these are presented in Section II.

The opinion of the Panel is that, in general, the conservative mass-balance approach utilized for the river model may be most suitable for a system-level assessment, where site-specific differences based on such factors as pooling effects and dams, for instance, may be neglected (e.g., as a screening tool to help define relative contributions of point *versus* non-point sources, and the effects of urban stormwater runoff, etc…). A concern of the Panel is that a model of this type may not provide the *spatial resolution* required to accurately reflect where eutrophication *hot spots* may occur. On the other hand, if phosphorus is totally decoupled from eutrophication in its use as a regulated substance, then a strong case could be made for modeling a large system using a simplified approach. But, this would not be the desired approach for developing discrete WLAs and LAs for the Passaic River watershed.

Specific points pertaining to the defensibility of the study:

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[7] For NPS loading, the draft report utilizes the UAL method as prescribed by NJDEP. A sensitivity analysis examining a range of ± 50% for the UAL coefficient values used in the study indicates that the model results are not particularly sensitive to the choice of UAL coefficient values (Table 3-11 in the draft report).

[8] It is not clear how the MS4s were handled in the draft report (e.g., were they included in the 0.05 mg/l LTA assigned to the municipal point sources, or in the 40% reductions in the NPS loading?).

[9] This section pertains to the river model. As a note pertaining to the reservoir model: In order to address the discrepancies between the observed and the model prediction for the Wanaque Reservoir, the report states in Section 2.4 (page 2-11) that "…. it is well known that phosphorus data are inherently variable, especially for concentrations less than 100 ppb". Some reference(s) supporting this statement should be included in the final report. The same statement is included in chapter 5 of the Najarian Associates (2000) reference, but this also has no supporting citation.

- The Error Analysis as presented in Table 3-1 is not sufficient to justify the use of the basic modeling approach for the current application. At a minimum, plots are needed of model simulations *versus* observations (with a 1:1 line) in order to assess the possibility of systemic bias in the model. This is especially critical when using a simplified model that considers known processes as negligible.
- It is not clear from the draft report how daily loads are calculated from Equation 1 in Section 3, as the point source loads are stated to be calculated on a monthly basis.
- For NPS load calculations (Eq. 2 of the same section), it is not clear why Q_{DIS} is used in the second term (C_{BF}*{$Q_{BF} - Q_{DIS}$}). If this results from how HYSEP estimates Q_{BF} and Q_{RUN} from Q_{RIV}, (e.g., $Q_{RIV} = Q_{BF} + Q_{RUN}$ = Actual $Q_{BF} + Q_{DIS} + Q_{RUN}$), then this should be clear in the report.[10]
- The use 0.01 mg/l TP concentration for C_{BF} in Section 3.1 requires a reference. Also, this value represents 20% of the criterion, so some measure of model sensitivity to this value seems pertinent here.
- The use of ortho-P equaling 80% of the discharge TP load in Section 3.2 also seems to warrant a discussion on model sensitivity to this particular value.
- In Section 3.2 (p. 3-5), monthly discharge data were only utilized for the four-year period for 1997-2000, and not from 1997 -2002. The reasoning for this should be explained in the report, as should exactly how the average discharges from this four-year period were used to provide monthly values for the remaining years of the simulation.

E. Critical Conditions (2002)

In a previous report, the Panel concurred with a recommendation by Najarian Associates that 2002 be included in model scenarios as a way to address both reserve capacity (i.e., higher withdrawal rates due to future growth), and the MOS, even if the severe drought of 2002 may be considered an anomaly.[11] Najarian Associates was to conduct both nine-year and ten-year simulations (omitting and including the 2002 drought year, respectively). The draft report does not provide an assessment omitting this drought year.

Also, a question was raised at the meeting by Tom Amidon (TRC Omni) as to the extent that the conclusion of Najarian Associates that the Passaic River is drawn into the Two Bridges intake 50% of the time depends on data from 2002 (as shown in Slide 12 of the presentation). The response from Dr. Najarian and subsequent comments by Mr. Amidon suggest that removal of the 2002 data would significantly reduce this percentage. This percentage, if much lower, would be one variable affecting the need for the dye study, the need of which was questioned by Dr. Najarian based in part on the 50% figure.

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[10] As a note, in the text relating to equations 2 and 3 it mentions that the UAL approach is more conservative in that it results in calculating roughly four times the average annual NPS load compared to a methodology of a previous study. The use of "conservative" to describe the over-estimate in NPS loading as compared to the former study is not "stakeholder neutral" and so perhaps a change in wording may be warranted here.

[11] Panel Report to NJDEP, Division of Watershed Management, November 13, 2003.

To the extent that the 2002 data may impact the need for the dye study, and more importantly TMDL development, it may or may not be defensible to use the summer 2002 data as a conservative driver for TMDL development. Whether or not the 2002 data should be incorporated into the TMDL development would depend on whether or not this year is a true outlier, which NJDEP and USEPA should assess. The Panel suggests that the analysis to eliminate the use of 2002 data may need to be made based upon precipitation, since MA7CD10 flows[12] for the watershed may not be readily available, and may ultimately be a function of point source discharges.

F. Alternative Endpoint - Summer Average Criterion

In a previous report, the Panel concurred with the development of this alternative endpoint, which is supported by the data presented in the draft report.[13] Although the New Jersey water quality criterion discussed here pertains to total phosphorus concentration, this is only a surrogate for addressing eutrophication. If the 2002 TP concentration data is eliminated from the analysis presented by Najarian Associates, then the peak predicted TP concentration occurs in the winter months when eutrophic conditions are not an issue, while the endpoint should be established to eliminate excessive algal blooms in the summer months (May 1 through October 31).

As indicated by the alternative endpoint presented in the draft report, which corresponds to seasonal (summer) compliance on a mean basis, it may be useful for NJDEP to study further whether or not these winter peaks in TP concentration should be incorporated in establishing an endpoint.

II. New Jersey Administrative Code Provisions Possibly Pertinent to TMDL Development in the Upper Passaic

The Panel would like to bring to the Department's attention certain provisions in the New Jersey Administrative Code that could seemingly impact the discussion here pertaining to the application of a basic mass-balance model for developing WLAs and LAs for TP TMDLs for the Passaic River watershed. The most relevant provisions are outlined below; a more complete list is provided in Appendix A.

In brief, the information below suggests that a basic mass-balance model cannot be used to develop TP TMDLs, due to (i) the complexity of the Passaic River watershed system; (ii) to the fact that sufficient data is available for development of a more detailed water quality model; (iii) that this more detailed model will be established concurrently or subsequently to the basic model presented in the draft report in a separately funded NJDEP project.

BASIC AND COMPLEX WATER-QUALITY MODELS

[12] Minimum average seven consecutive day flow with a statistical recurrence interval of 10 years.
[13] Panel Report to NJDEP, Division of Watershed Management, November 13, 2003.

N.J.A.C. 7:15-7.4 Development of basic TMDLs

(a) A basic TMDL model may be established for waterbody segments when insufficient data are available to develop a complex TMDL model and the complexity of the waterbody segment and the wasteload inputs to the waterbody segment do not justify development of a complex TMDL model. A basic TMDL model includes all TMDL models where a fully calibrated and verified water quality model has not been developed for the parameter(s) of concern. A basic TMDL model may consist of but is not limited to a mass balance for the waterbody segment for appropriate parameter(s) of interest….

N.J.A.C. 7:15-7.3 General technical requirements for TMDL development

(a) TMDLs may be established using either a basic TMDL model approach or a complex TMDL model approach. Where a basic TMDL model has been established and a complex TMDL model is subsequently established for the same parameter and the same waterbody segment, WLAs and LAs shall be established using the complex TMDL model and shall replace the WLAs and LAs established using the basic TMDL model….

III. Concluding Remarks

One of the objectives for this study by Najarian Associates is to provide the Department with TP loading values that are predicted to result in the Wanaque Reservoir attaining the 0.05 mg/l TP concentration criterion; these values are to be used in more detailed modeling efforts for the Passaic River by TRC Omni. Based on the discussion here, the loading values provided by the draft report may not be entirely applicable for this objective as:

1. The simulations for the study were not conducted for the correct set of boundary conditions
2. Loading values were not also provided for nine-year simulations that do not incorporate the 2002 drought year.

Once the applicable TP loading values are agreed upon, the Panel recommends that NJDEP provide TRC Omni with a range of endpoints, representing a tradeoff between loadings from municipal dischargers and non-point sources, which are simulated to attain the applicable criterion for the reservoir, rather than only a single value.[14] Such a range would allow TRC Omni to examine a variety of scenarios throughout the watershed, and generate reasonable WLAs and LAs that conform to the simulated attainment of the criterion for the Wanaque Reservoir. It is important to note that the NPS loading values must be explicitly provided in the final report by Najarian Associates.

Some final points in closing:

[14] The single loading value from the draft report corresponds to the established surface water quality criterion for the Wanaque Reservoir, and consists of a total TP loading from municipal dischargers of 32 lbs/day, plus the loading corresponding to the 40% NPS reduction.

- NJDEP has indicated that it may consider replacing the dye study with model simulations of "no mixing" and "all mixing" scenarios, the results of which would sufficiently allow NJDEP to assess the situation without the study. The Panel suggests that conducting additional simulations in order to provide a sensitivity analysis of the mixing may be more appropriate here, and then perhaps selecting a worst-case scenario for TMDL development. Such an analysis may also help with the MOS issue.

- The presentation assumed that the LTA concentration for point sources would be 50% of any permit limit imposed (e.g., the LTA would be 0.5 mg/l if a 1.0 mg/l discharge limit was imposed). For phosphate, the Panel questions whether the LTA might be higher than this, as treatment plants will strive to save costs by more closely approaching (e.g., 75%) their permit limits.

- A significant amount of time and resources have been spent on data collection and modeling for development of TP TMDLs for Passaic River watershed. The Panel notes that a similar effort should be spent on developing an implementation plan for these TMDLs. Rutgers University has received a grant from USEPA to examine water quality trading as one tool for TMDL implementation. Some mention of this trading project should be placed in the TMDL implementation plan for the Passaic River watershed to help dischargers achieve water quality criteria in a cost effective manner. For instance, such trading could potentially result in a collation of discharges joining together to relocate the Two Bridges outfall downstream of the water intake, or result in trading between MS4s and wastewater treatment plants.

- As a preemptive suggestion for the Phase II water quality modeling efforts by TRC Omni: The study by Najarian Associates has used a 10-year data set (1993-2002) for model testing, while TRC Omni will be applying data that was collected in a single year (2003) during Phase I of their project for model calibration and verification. Concern has been expressed over the suitability of the 2003 data set, as it was a "wet" year, and severe bloom episodes indicative of eutrophic systems may not have occurred with the intensity that might occur during normal or "dry" years. The Panel therefore suggests that:

    - In order to increase the robustness of their model, TRC Omni should test the model against the data set used by Najarian Associates, especially should the data collected in 2003 prove to be less than ideal for model development.

    - Should the 2003 data collected in Phase I of the TRC Omni project prove to be inappropriate for TMDL development for the Passaic River watershed, then the possibility of collecting data in 2005 should be explored by NJDEP.

    - To the extent that models are not static entities (i.e., validated once and then used over and over again), but are in reality dynamic entities, gaining in robustness as they continue to be tested and validated against subsequent data sets, then the TRC Omni model currently under development should be

understood to serve as the starting point for a truly comprehensive water quality management tool.

Lastly, in order to support the Department in obtaining a scientifically and legally defensible document, the Panel recommends a follow-up meeting with NJDEP and Najarian Associates to supplement this report. The Panel requests that this meeting be held prior to preparation of the final report by Najarian Associates. This will help ensure that the critical issues identified here are addressed in the final deliverables to the Department.

Appendix A - New Jersey Administrative Code Provisions Possibly Pertinent to TMDL Development in the Upper Passaic

DESIGN FLOWS

N.J.A.C. 7:9B-1.5(c)(2) Water quality criteria are expected to be maintained during periods when nontidal or small tidal stream flows are at greater than the appropriate design flow…. For acute aquatic life protection criteria, the design flow shall be the MA1CD10 flow. For chronic aquatic life protection criteria for ammonia, the design flow shall be the MA30CD10 flow. The design flow for all other criteria shall be the MA7CD10 flow.

TMDLs FOR PARAMETERS

N.J.A.C. 7:15-7.2(c) A separate TMDL shall be established for each pollutant parameter identified in accordance with N.J.A.C. 7:15-6.2(c), … and may be established for other pollutant parameters where these parameters are identified through the public process…or through supplemental public notice after the TMDL process has commenced. However, more than one TMDL can be developed for a[n] [impaired stretch] using a consolidated public process and TMDL modeling approach. Each TMDL shall be developed and approved in accordance [with NJDEP regulations].

IMPLEMENTATION MECHANISMS

N.J.A.C. 7:15-7.2(h) Where feasible, the TMDL proposal shall include: 1. The various management options and alternatives which will ensure that the surface water quality standards will be attained, including the use of BMPs, the trading of allocations…, or the use of water conservation measures; 2. A listing of all pollutant sources discharging into the waterbody segment for which WLAs or individual LAs were developed, and all nonpoint source pollutant categories for which aggregate LAs were developed;….

BASIC AND COMPLEX WATER-QUALITY MODELS

N.J.A.C. 7:15-7.4 Development of basic TMDLs

(a) A basic TMDL model may be established for waterbody segments when insufficient data are available to develop a complex TMDL model and the complexity of the waterbody segment and the wasteload inputs to the waterbody segment do not justify development of a complex TMDL model. A basic TMDL model includes all TMDL models where a fully calibrated and verified water quality model has not been developed for the parameter(s) of concern. A basic TMDL model may consist of but is not limited to a mass balance for the waterbody segment for appropriate parameter(s) of interest….

(b)(2) A basic TMDL model (using only a mass balance) shall not be established for any pollutant or pollutant parameter which has a substantial direct effect on the dissolved oxygen dynamics of the stream….

(c) Basic TMDL models eligible to use and using mass balance equations shall assume that each pollutant or pollutant parameter is conservative. The maximum quantity of instream water available for mixing in non-tidal waters is limited to the inflow entering the waterbody segment within the spatial boundaries of the TMDL. Where water is withdrawn from upstream of an effluent discharge point and subsequently reintroduced to the same waterbody segment at a downstream location (the discharge point) as effluent flow, the general mass balance equation shall be modified to account for the withdrawal of flow and associated pollutant loading.

N.J.A.C. 7:15-7.3 General technical requirements for TMDL development

(a) TMDLs may be established using either a basic TMDL model approach or a complex TMDL model approach. Where a basic TMDL model has been established and a complex TMDL model is subsequently established for the same parameter and the same waterbody segment, WLAs and LAs shall be established using the complex TMDL model and shall replace the WLAs and LAs established using the basic TMDL model….

(b) The spatial boundaries for each TMDL shall be clearly established and shall begin and end at a waterbody segment boundary as defined by the USEPA stream segments database, except when the Department determines on a site specific basis that an alternate spatial boundary is appropriate. TMDLs for adjacent segments may be combined to provide a comprehensive TMDL for all of the affected segments….

(d) Except for statistical models, stream design flows for TMDLs shall be determined in accordance with N.J.A.C. 7:9B. For statistical models, the stream design flow may be determined from analysis of waterbody segment flow data… and shall take into consideration existing or potential impacts of water flows from upstream flow regulation facilities (such as reservoirs) and inter-watershed transfers of water or wastewater…..

MS4S AND TMDLS

N.J.A.C. 7:15-7.6(d)(3)(iii) All pollutants discharged under a general permit with numeric limitations for the parameter of concern shall be considered as part of the TMDL process and may receive an allocation.

ALLOCATION METHODOLOGIES

N.J.A.C. 7:15-7.6(d)(4) At a minimum, the following general approaches shall be considered in the development of allocation options…. Options may be applied across all categories of pollutant sources or for specific categories of pollutant sources (such as, but not limited to, major domestic treatment works, minor domestic treatment works, similar industrial categories, stormwater discharges). The options shall be examined in general, and then examined in detail only where they are found to be reasonably applicable to the specific TMDL:

(i) Allocation of an equal effluent concentration to each source, for each pollutant or pollutant parameter;
(ii) Allocation of an equal percent removal to each source, for each pollutant or pollutant parameter;
(iii) Allocation of an equal effluent mass loading to each source, for each pollutant or pollutant parameter; and
(iv) Minimization of the total treatment expenditure for the entire waterbody segment. This process may include trading of allocations among point source inputs and/or nonpoint source inputs of pollutants so long as the water quality standards shall be attained throughout the waterbodies addressed by the TMDL and at the edge of the regulatory mixing zone for any single point source discharge.

SEASONAL AND SITE SPECIFIC TMDLS AND WLAs

N.J.A.C. 7:15-7.6(h) Seasonal WLAs or site specific allocations may be developed in accordance with the following conditions:

1. Each seasonal WLA shall be derived from a seasonal TMDL;
2. Seasonal WLAs or site specific allocations may be developed for the following parameters and groups of parameters: (i) Parameters substantially affecting dissolved oxygen dynamics in the receiving stream; (ii) Nutrients, including phosphorus and nitrogen; and (iii) Ammonia-N limitations to protect against toxic effects in the receiving water.

Interim Report: Panel Comments – Draft final report *Development of Wanaque Reservoir TMDL and Cumulative TMDLs for the Pompton and Passaic Rivers* by Najarian Associates*, February 2005*.
Submitted April 15, 2005

The draft report is generally well-written and comprehensive, and addresses the bulk of the Panel comments pertaining to the previous draft.[15] However, there are several issues from its prior report that the Panel would like to reiterate to the Department.

I. Critical conditions

The draft report does not include the 9-yr simulation (i.e., omitting the 2002 water year), which was recommended by the Panel to be included in the study.

From the draft report, p. 5-4:

> For the summer-average endpoint (Endpoint 2), Year 2002 was the most critical…results for this year effectively determined Endpoint 2 compliance. This determination is consistent with requirements that TMDLs be developed for critical conditions, and is consistent with future trends. As population increases, so will water demand and the likelihood of such drought conditions.[16]
>
> Historical rainfall records…total precipitation for the water year (October 1, 2001 through September 30, 2002) was 31.44 inches – ranking 3rd lowest over the past 48 years. While this is somewhat unusual, it is not an extreme hydrologic event. Thus, critical year 2002 was considered in the analysis.

There a few points to note here based on the revised draft:

1. From p. 7.2, reserve capacity is specifically accounted for: "Reserve capacity is included implicitly through the following assumptions: (1) the reservoir diversion schedule reflects its ultimate safe-yield capacity; and (2) treatment plant discharge rates reflect each facility's design flow rate." Thus, assumption (1) presumably already addresses future increases in water demand.

2. The report now includes an explicit MOS. From Section 6-1, an explicit 20% MOS for the 0.05 mg/l criterion has now been applied solely to the point sources, which effectively amounts to a 37% MOS for the point source effluent TP LTAs.

3. The historical rainfall records cited in the draft report indicate that the 2002 water year corresponds to the lowest 10th percentile for precipitation over 100 years.

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[15] Interim Panel Report to NJDEP, Division of Watershed Management, Submitted December 2, 2004.
[16] The wording that drought conditions are coupled to population increases is problematic. More correct wording would be *drought like*, or *low-flow* conditions, which may be coupled to increased water demand.

4. It may be seen from Figure 5.9 of the draft report that the model simulations for the peak summer-averaged [TP] are tightly grouped for the effluent TP LTAs from 0.10 – 0.50, except for the 2002 water year. Thus, not only is Year 2002 critical in terms of compliance, but exclusion of it makes for a less discernable distinction in the simulated peak summer-averaged [TP] for all of the effluent LTAs, particularly for those ranging from 0.10 – 0.50. This observation is summarized in the following table.

Endpoint Compliance Based on Model Simulations [a]

Effluent LTA (mg/l)	**Discharge Load (lbs/day)**	**End Point 2 Max. Summer-Average Concentration (mg/l)**	
		Including 2002 (as in the NA draft final report)	Excluding 2002 and estimating values from Figure 5-9
0% NPS Load Reduction			
1.00	650	0.079 [b]	0.039
0.50	325	0.055	0.030
0.25	160	0.043	~ 0.025
0.10	65	0.036	~ 0.025
40% NPS Load Reduction			
1.00	650	0.069	0.035
0.50	325	0.046	0.027
0.25	160	0.035	~ 0.025
0.10	65	0.028	~ 0.025

a. Adapted from Tables ES 1, 5.1 and 5.2, and Figure 5.9 of the draft final report.
b. This value is estimated from Figure 5.9, and was not provided in the original tables.

Based on the above observations, it may be that inclusion of the 2002 water year in establishing the TMDL for the Reservoir may be too stringent a condition.

II. The River Model

The current draft notes in support of the conservative mass-balance approach utilized for the river model that NJDEP (1987) previously monitored and modeled the fate and transport of P throughout the Passaic river during summer conditions: "…The comprehensive QUAL-2E study indicated that TP as essentially a conservative constituent within most of the Passaic River…"

QUAL2E is a one-dimensional water quality model that assumes steady-state flow, but allows for simulation of diurnal variations in temperature or algal photosynthesis and respiration. The USEPA Compendium of Tools for Watershed Assessment and TMDL Development (EPA841-B-97-006, May 1997), for instance, presents several dynamic

water-quality models by comparison. Constituents that QUAL2E does not simulate include, for instance:[17]

- pH/carbonate system
- Sediment
- Benthic macrophytes/periphyton
- Sorbing constituents, such as particulate N, P
- Diurnal DO

The Panel thus reiterates its point from the previous report that there are certain provisions in the New Jersey Administrative Code (below) that impact the use of the conservative mass-balance approach utilized for the river model. These provisions suggest that a basic mass-balance model cannot be used to develop TP TMDLs, due to (i) the complexity of the Passaic River watershed system; (ii) to the fact that sufficient data is available for development of a more detailed water quality model; (iii) that this more detailed model will be established concurrently or subsequently to the basic model presented in the draft report in a separately funded NJDEP project.

BASIC AND COMPLEX WATER-QUALITY MODELS

N.J.A.C. 7:15-7.4 Development of basic TMDLs
(a) A basic TMDL model may be established for waterbody segments when insufficient data are available to develop a complex TMDL model and the complexity of the waterbody segment and the wasteload inputs to the waterbody segment do not justify development of a complex TMDL model. A basic TMDL model includes all TMDL models where a fully calibrated and verified water quality model has not been developed for the parameter(s) of concern. A basic TMDL model may consist of but is not limited to a mass balance for the waterbody segment for appropriate parameter(s) of interest….

N.J.A.C. 7:15-7.3 General technical requirements for TMDL development
(a) TMDLs may be established using either a basic TMDL model approach or a complex TMDL model approach. Where a basic TMDL model has been established and a complex TMDL model is subsequently established for the same parameter and the same waterbody segment, WLAs and LAs shall be established using the complex TMDL model and shall replace the WLAs and LAs established using the basic TMDL model….

III. Municipal Separate Storm Sewer Systems (MS4s)

The draft final report still needs to explicitly identify the MS4s, and then assign the corresponding WLAs based on the estimated load reductions for the nonpoint sources, applied to the surrogate land use for regulated stormwater (urban categories: residential, commercial, industrial).

[17] This list is from a USEPA BASINS Training Workshop, May 14-18, 2001, Logan Utah, except for Diurnal DO, which Dr. Obropta makes note of as well. QUAL2E does simulate average DO.

IV. Reserve Capacity

As noted in Section I, reserve capacity is included implicitly in the analysis through the following assumptions: 1) the reservoir diversion schedule reflects its ultimate safe-yield capacity; and (2) treatment plant discharge rates reflect each facility's design flow rate. However, these assumptions would not address, for instance, future development of forest land, or future MS4s.

The Panel notes a possible alternative when addressing reserve capacity, either for the Passaic River watershed, or for other systems. Perhaps the responsibilities related to addressing reserve capacity should lie instead with the actual future development itself, rather than being imposed on the existing conditions as in the current method. This would mean that a reserve capacity would not be explicitly incorporated in the TMDL calculations. Instead, future development (which would include increased point source discharges) would need to offset the resulting increased loading, e.g., via BMPs or nutrient trading.